Exploring the influence of sources, behaviour and mitigation strategies on aerosols generated during household activities

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Indoor air quality (IAQ) is influenced by aerosols emitted and formed *in situ* from a broad range of sources and human activity such as cooking and cleaning. Uncertainties remain in understanding the relationship between human behaviour and aerosols of chemical and biological nature, their emission source strengths and spatial variability in the home (Braniš et al., 2014; Nazaroff, 2016).

A systematic approach to measuring the impact of indoor activities informed by human behaviour is extremely valuable and should allow the extrapolation of experimental findings. As such, this novel study makes use of the UK Time Use Survey (UK-TUS) (Gershuny *et al.* 2017) to define a typical day and explore how IAQ evolves with different behaviours by defining a framework for systematic study of IAQ typical of a UK home.

This preliminary work determines aerosol emission factors for individual indoor activities and the determination of the emissions and evolution of those emissions in time and space within the time-use framework. Emissions factors are measured using a simple source emissions system whereby total emissions are captured in a flow of clean air and extracted over a suite of aerosol and trace gas instrumentation for a range of cooking methods and meals. Activities are then completed within the chamber outfitted with an array of low-cost and traditional measurement technologies to determine the emissions and the distribution of emissions with the indoor environment under a range of ventilation levels.

We report preliminary results of the first study using the *DOMESTIC* facility for studying human activity and air quality in the built environment at The University of Chester. *DOMESTIC* consists of a controlled chamber-like indoor space outfitted for studying cooking, cleaning and ventilation and associated instrumentation laboratory. We focus on results comparing sensor technologies, traditional methods, and modelling.

Size-segregated aerosol number, ultrafine particle number and particulate mass are studied using both standard and low-cost instrumentation, as well as bioaerosols which are investigated through both online and offline techniques. The study also probes the relationship between indoor and outdoor aerosol components.

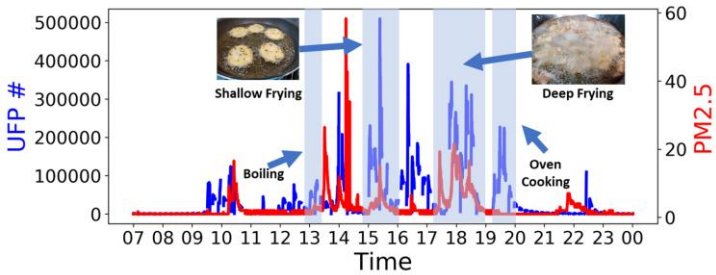

Figure 1 – Relative differences in ultrafine particle number (UFP) and PM2.5 during different cooking activities with extract ventilation on for the duration.

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References

Gershuny, J.I., Sullivan, O. (2017). *United Kingdom Time Use Survey, 2014-2015*. [data collection]. UK Data Service. SN: 8128, http://doi.org/10.5255/UKDA-SN-8128-1

Nazaroff, W. W.: Indoor bioaerosol dynamics, Indoor Air, 26(1), 61–78, doi:10.1111/ina.12174, 2016.

Braniš, M., Řezáčová, P. and Lazaridis, M.: The effect of source type and source strength on inhaled mass of particulate matter during episodic indoor activities, Indoor Built Environ., 23(8), 1106–1116, doi:10.1177/1420326X13499360, 2014.

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